Religio Chirurgi.

We have received an address to theological students by that famous and well-beloved old surgeon, Dr. W. W. Keen of Philadelphia, the master and the representative of American surgery, whose work has long been honoured over here. He gives to his address the title "Science and the Scriptures"; but, of course, he is concerned with that hardship of thought which all of us confess. In America, he says, there is a mischievous "recrudescence of the warfare over Evolution": and he sets himself, by sixty-two years' study and teaching of anatomy and surgery, to confute such people as look for their science to the Book of Genesis, and say that man was "a separate direct creation." He finds it easy enough to establish a more reasonable view, and we over here can only wonder that it should now be necessary to do so. The distinctive mark of this address is, however, Dr. Keen's determined will to be as strong in the Christian faith as in his reasons touching evolution.

> "I believe that man, himself, will only attain his final development in the future life beyond the grave. In that wondrous life I believe as fully as I do in my own present existence. . . . Bodywise, man is an animal; but, thanks be to God, his destiny is not the same as that of the beasts that perish. To develop great men, such as Shakespeare, Milton, Washington, Lincoln, and then by death to quench them in utter oblivion would be unworthy of Omnipotence. To my mind it is simply an impossible conclusion. Man's soul must be immortal."

Therefore, Dr. Keen invents a phrase that the moral and spiritual life of man has been "engrafted upon" his natural life. The phrase is, however, unsatisfying. Man's likeness bodywise to animals is acknowledged, but Dr. Keen evades the animal's likeness conductwise to man. What is the use of Shakespeare and Milton to us who do not admit any great difference or gap between animals at their highest and man at his lowest?

Doubtless, in this quandary, it may advantage us to remember that no science has anything to say about personality. There is a lot of slipshod talk about organisms; but not a word about the animal itself, the inscrutable person which is the cat or the dog, the very self which is "engrafted upon" the animal organism. Until we understand—which possibly we never shall—the mystery and secret of the creation of animals, we shall remain in a quandary that is too deep for scientific analysis. The only way of escape seems to be that which Dr. Keen has taken. It reconciles no difficulties. It holds things apart, not brings them together. Still, he is not the only man, full of age and experience, who has taken this way; and we may get, from his outspoken declaration of faith, a touch of that delight which Socrates always found in talking to old men.

Chemical Technology.

(1) *The General Principles of Chemical Engineering Design.* By Hugh Griffiths. (Chemical Engineering Library.) Pp. 63. (London: Benn Brothers, Ltd., 1922.) 3*s.* net.

(2) *Materials of Chemical Plant Construction—Non-Metals.* By Hugh Griffiths. (Chemical Engineering Library.) Pp. 64. (London: Benn Brothers, Ltd., 1922.) 3*s.* net.

(3) *The Weighing and Measuring of Chemical Substances.* By H. L. Malan and A. I. Robinson. (Chemical Engineering Library.) Pp. 63. (London: Benn Brothers, Ltd., 1922.) 3*s.* net.

(4) *The Flow of Liquids in Pipes.* By Norman Swindin. (Chemical Engineering Library.) Pp. 64. (London: Benn Brothers, Ltd., 1922.) 3*s.* net.

(5) *Pumping in the Chemical Works.* By Norman Swindin. (Chemical Engineering Library.) Pp. 80. (London: Benn Brothers, Ltd., 1922.) 3*s.* net.

(6) *Recent Progress in Rubber Chemistry and Technology.* By Dr. P. Schidrowitz. Pp. 64. (London: Benn Brothers, Ltd., 1922.) 3*s.* net.

It was, we believe, Pascal who observed that knowledge tends to concentrate itself in little books. The half-dozen monographs, published by Messrs. Benn Brothers, of which the titles are given above, are at least an exemplification of the truth of this aphorism. They form members of a series intended primarily for the use of the chemical engineer. The information they afford is given in what may be called "tabloid" form. They are small octavo booklets of some sixty or seventy pages, and are suitably illustrated. The actual amount of letterpress is, therefore, very small. Still, small as they are, they are packed with useful data, and as they are compiled by authorities and are brought up-to-date, they will no doubt be found useful by the class of technologists for whom they are more particularly designed.

(1) "The General Principles of Chemical Engineering Design," by Mr. Hugh Griffiths, treats of the essentials of a successful chemical plant: its physical, chemical, and mechanical factors; its practical and economic factors; and the settlement of the final design in the light of experience of the working of these factors—a matter frequently of no small difficulty in view of the complexity of the problem. The book may be regarded as introductory to the series. It deals simply with first principles and generalities, illustrated here and there by facts based upon practical experience. It is well written and suggestive, but contains little but what a chemical manufacturer is already well aware of, from, it may be, a more or less painful experience. The little book would serve admirably as the intro-

ductory discourse to a course of instruction on the technique of chemical manufacture.

(2) In his little work on materials of construction Mr. Griffiths deals with facts rather than with principles. In his introduction he speaks somewhat contemptuously of the designing engineer who has but little knowledge of chemistry, and of the research chemist who is ignorant of even the most elementary principles of mechanics, both of whom know little or nothing of the behaviour of materials of construction towards the action of chemical substances under the special conditions of the manufacture, but who are yet called upon, one to design and the other to work the plant.

There is no doubt that in too many cases the strictures are well merited. So long as chemical manufacture is confined, as in the case of so-called "heavy chemicals," to comparatively few substances and those of a restricted class, the disastrous results, material and financial, of such ignorance are not likely to be very serious. But as the range of his work extends, the chemist is called upon to face an increasing complexity of conditions in manufacture, and he cannot be too well informed concerning the application of constructional materials to chemical plant: he must know, not only the usual influences of atmospheric action, weathering, rusting, etc., but also the effects of physical conditions and the specific action of substances in varying circumstances of temperature, pressure, catalytic influences, etc.

In the space of some six or eight short chapters the author deals with the properties of bricks and tiles, refractories; stone, natural and artificial; ceramic materials and glass; rubber, ebonite, leather etc., wood; and a variety of non-metallic materials, such as mortar, cement, lutes and jointings, paints and enamels. In the very limited space allowed to the author, the treatment is necessarily highly condensed, but it gives the essential facts accurately and in sufficient detail.

(3) The little book on "The Weighing and Measuring of Chemical Substances," by Messrs. Malan and Robinson, is concerned solely with these operations as they may, or should be, carried out in chemical works. It deals with the general mechanical principles and theoretical considerations applicable to the various types of instruments employed. These, of course, differ according to the physical nature of the substance to be weighed or measured, *i.e.* whether solid, liquid, or gaseous. All the commoner forms of apparatus are referred to, as well as those of modern type, some of which are of rather elaborate construction and need intelligent use. The booklet may be commended as a useful account of methods to be employed in checking the various stages of the production of a manufactured article with the view of economy and the prevention of waste.

(4, 5) The two books by Mr. Norman Swindin on the flow of liquid chemicals in pipes and chemical works pumping are concerned with associated subjects of great importance to the chemical engineer. In the first-named the general principles involved in the consideration of viscous flow—kinematic and absolute viscosity, the relation between mean velocity and velocity at axis of pipes, the practical application of the kinematic viscosity equation, the flow of liquids in channels, and pipe-line losses—are set out in such detail as the very limited space at the author's disposal permits.

Justice is done to the classical work of Osborne Reynolds and to the more recent investigations at the National Physical Laboratory by Dr. Stanton, and of Mr. E. Parry of the English Electric Company. In the discussion of the various formulæ for expressing the relation between viscosity and temperature, Rodger, the collaborator of Thorpe in their investigation of the connexion between viscosity and chemical constitution, is inadvertently spelt Rogers. The book concludes with a number of useful tables showing the viscosities at different temperatures and the densities of various liquids of importance in the chemical arts.

The booklet on pumping contains a description of the construction and mode of working of pumps employed in connexion with corrosive liquids—a problem of a very different order of difficulty compared with that with which the hydraulic engineer has usually to contend. The various types of pumps applicable to the conditions in chemical works are succinctly described with the aid of suitable figures and diagrams. Both books are useful compilations, and will be of service to the works manager and chemical engineer.

(6) Dr. Schidrowitz's little book on "Recent Progress in Rubber Chemistry and Technology" is a work of a very different order, and is in no wise connected with the Chemical Engineering Library. It deals more particularly with the extraordinary development of our knowledge concerning the nature of rubber, especially of plantation rubber, the conditions of its economical production, the mechanics of vulcanisation, the properties of vulcanised rubber, and the technique of rubber manufacturing processes—a development largely due to the creation of the tyre industry. Dr. Schidrowitz is an acknowledged authority on the subject of his book, and it is certain, therefore, to command the attention of all who are interested in rubber, whether as producers or as manufacturers. It is significant how little is heard to-day of synthetic

rubber; as a possible competitor of the natural variety its future appears hopeless. More plantation rubber is being produced than the world at present requires, or is likely to require for some time to come. At the same time, the investigations which have led to the synthesis of rubber, or of rubber-like substances, have great theoretical value, and have shed much light on the true nature and chemical constitution of this most remarkable substance.

Forward Progression.

Gaseous Exchange and Physiological Requirements for Level and Grade Walking. By Henry Monmouth Smith. (Publication No. 309.) Pp. viii + 310. (Washington: Carnegie Institution, 1922.) 6 dollars.

FORWARD progression, perhaps the form of muscular activity most commonly engaged in by the average human being, is, both in its anatomical and physiological aspects, one of extraordinary complexity. The work of Marey, Carlet, Braune and Fischer has thrown much light on the actual movement of the body and legs during the forward movement, and the researches of Zuntz and Schumburg, Durig, Douglas, Benedict and Murschhauser, and others have helped towards the elucidation of the metabolism and energy expenditure of the movement. A number of problems which have emerged from the previous investigations still remain unsolved; some of these questions are discussed, and in part elucidated, in this new volume from the Carnegie Institution's Nutrition Laboratory at Boston.

This book forms the natural sequel to the work of Benedict and Murschhauser. These workers dealt with the changes in the metabolism, the cost and the efficiency of the human body during horizontal walking. Monmouth Smith's work, although ostensibly it is meant to deal principally with "grade" walking, contains much new data on horizontal walking, more especially as regards the influence of the movement and change of position on the blood pressure, pulse and temperature. The effect of horizontal walking on the blood pressure is not great; as regards the pulse rate, one of the most striking features is the great variation found in the same subject under apparently identical conditions. In connexion with the rectal temperature several interesting facts emerge: (*a*) there is a definite lag in the rise of temperature which occurs in changing from standing to walking; (*b*) except at the higher rates the effect of the rate of walking is small; and (*c*) the maximum increase at any speed less than 100 metres per minute does not exceed 0·5° C. (without taking into consideration the duration of the exercise). Many new observations have also been made on the "step-lift." A slightly lower value for the cost of this operation than that of previous workers was found. A slightly lower value than that commonly accepted was also found for the energy cost per horizontal kilogrammetre.

In the grade-walking experiments a preliminary series of experiments were made on the influence of the mouthpiece on the breathing of the subject. These tests are of considerable technical interest. The general result is that unless the preliminary period of breathing with the mouthpiece in position be of sufficient duration, the accuracy of the determination of the respiratory quotient is endangered.

A large number of observations were also made on the influence of grade walking, in addition to the determination of the energy cost, on the blood pressure, pulse, pulmonary ventilation, and temperature. Those on the temperature are particularly interesting. It was found, for example, that the temperature increase was not always the same for the same amount of work, although, as might be expected, a higher temperature and a greater increase over normal were usually observed when the work and the metabolism were greatest. The maximum total increase, when the work done was heavy, was between 1·5° C. and 2° C. A number of very interesting experiments on the rate of the fall of the rectal temperature after the cessation of work are recorded. In one experiment at least it was very rapid, 1·14° C. in twelve minutes, or 0·09° C. per minute. On the other hand, if observations were continued, the rectal temperature was found to approximate normal pre-work temperature only about two hours after the cessation of work.

The Nature of Science.

What is Science? By Dr. Norman Campbell. Pp. ix + 186. (London: Methuen and Co., Ltd., 1921.) 5*s.* net.

"WHAT is Science?" is a question that may be answered in as many ways as "What is Truth?", and much depends on the questioner. In this case the original questioner was apparently an audience drawn from the Workers' Educational Association. Fifty or more years ago the worker was all agog for science; now, it appears, he either shoulders it aside as too academic for practical use, or rejects it as the "stone" of vocational education proffered instead of the "bread" of culture. The worker, in this limited sense, is not alone in misapprehending what is meant by "science," for the public at large, as recent years have given abundant proof, often blames it for sins